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Synthesis of Cr-doped UO_2 nuclear fuel pellets with controlled microstructure

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In current nuclear power plant reactors, energy is produced by the fission of uranium and/or plutonium isotopes, contained in oxide pellets made of single phase UO_2 or polyphase $(\text{U,Pu})\text{O}_2$ (MOX). The fission reaction creates fission products that are contained inside the fuel. Those fission products are liable to be released outside of the reactor in case of severe accident. The released amount depends on the thermodynamic conditions during the accident and on the chemical state of the fission products. This is why a deep knowledge of the fission products behavior in the fuel in case of accident is absolutely needed in order to anticipate and estimate the consequences of the accident. Many studies have been carried out to identify the chemical state and quantify the release of fission products in simulated virgin UO_2 fuels (SIMFUELS) and in real irradiated UO_2 and MOX fuels under different thermodynamic conditions.

UO_2 fuel doped with chromium is part of “E-ATF” (Enhanced Accident Tolerant Fuel). It is studied for its great behavior in case of accidents (power ramp), due to a larger grain size compared to a classic UO_2 fuel. Nevertheless, the added chromium is likely to react with some fission products and form volatile species that would be not found in non-doped UO_2 fuel. The BENEFICIA (BEhavior of NEw Fuels In Case of Incidents and Accidents) project, financed by the ANR (French National Research Agency) proposes to determine the source term (nature, quantity and kinetics of released fission products) of the chromia doped UO_2 fuel, through different studies. One of them is about the speciation of fission products in a Cr-doped SIMFUEL.

Therefore, for the synthesis of these SIMFUELS, the sintering process is under study in order to control the microstructure of the pellets. The influence of the thermal cycle and the oxygen potential on the sintered pellet density and grain size, and on the chromium speciation and distribution has been studied and will be presented.